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STARLING ATTACKS UPON WARBLE INFESTED CATTLE IN THE GREAT PLAINS AREA[1]

Arthur L. Goodrich, Jr.

Introduction

The European Starling (Sturnus v. vulgaris Linnaeus), introduced successfully into the United States about 1890, is a member of an old-world family of birds. Its close relatives are indigenous to Africa, Europe, India and adjacent areas. There are approximately 70 known species belonging to about 20 genera in this family. Near relatives of the starling, termed mynahs, may now be nesting in the wild state near Los Angeles, California, and in the Pacific Northwest (Ryan, 1930).

This paper has been written in an effort to present a record of the attacks of starlings upon cattle of which only incomplete and rather garbled accounts have been published in the press.

Starlings are about eight and a half inches long, possess a slender beak as long as the head, and have metallic purplish or greenish plumage. Many of the feathers are tipped with buff and appear thus in winter, but the tips wear off, so that by late spring there may be little evidence of buff. Birds less than a year old tend to show much more buff and have whiter underparts than older specimens. The tail is short and square. They are essentially ground feeders, subsisting upon an omnivorous diet of grubs, caterpillars, worms, fruits, berries, and other foods. They mate among the earliest of the song birds, constructing nests of grass, twigs, and related materials, in holes in trees, or in protected places. The female lays from four to seven pale blue eggs, and may rear two broods a year.

Introduction and Spread

The presence of starlings in the United States is believed to be the result of releasing two groups totaling about 100 birds in Central Park, New York City, in 1890 and 1891. Records indicate starlings were first released in the United States at Cincinnati, Ohio, in 1872 (Collinge, 1937). The birds apparently did not become established at this time. Subsequent importations were made into New York in 1877, and at Portland, Oregon, in 1889 and 1892. Starlings in the Pacific Northwest are possibly the descendents of these importations into Portland. It is possible that unsuccessful importations date back to 1850 (Stack, 1933). About 1909, the Secretary of Agriculture used his powers to place the name of the European Starling upon the list

[1]Contribution No. 214 from the Department of Zoology, Kansas State College, Manhattan, Kansas. The author wishes to acknowledge the assistance of members of the Department of Entomology, Kansas State College, in gathering the data for this paper.

of animals to be denied entrance into the United States by the Customs officials.

As a result of the successful importations of 1890 and 1891, starlings became numerous around Greater New York City by 1900. Their rapid spread from this focus was hindered by severe winter conditions and by lack of an instinct to migrate in their new environment. Gradually, however, they spread westward and southward, crossing the Allegheny mountains by 1916, for a specimen was taken at West LaFayette, Ohio, in January, 1916 (Hicks, 1933). In 1928 the breeding range, where starlings were present in sufficient numbers to be of economic significance, was said to be from southern New England to Virginia, west to central Pennsylvania and western New York (Cook, 1928).

Starlings were found at Ypsilanti, Michigan, in 1922, and are said to have been found in Illinois the same year (Baker, 1937). They were first found nesting in Madison County, Indiana, in 1927. Starlings were reported from Tulsa and Norman, Oklahoma, during severe weather in December, 1929, and January, 1930 (Chase, 1930), and from at least two areas in Kansas in the early months of 1930 (Davidson, 1933, and Bunker, 1930). Wetmore (1933) reported the westernmost extension of their range in 1932 as Bridgeport, Oklahoma, and Strawn, Texas. Starlings were identified on a Utah ranch in February, 1939 (Condor, 41(4):170, 1939).

Economic Status

Opinion differs among ornithologists of this country and abroad as to the economic status of the starling. Allen (1934), in one of his inimitable autobiographies of birds, makes the starling say: "In deed, those who are not raising cherries or berries have every reason to thank the good man who brought us over to this country which needs our services so badly." Collinge (1937) records that the balance might be considered to be on the beneficial side in the United States and Canada, but that in England, where maximum numbers seem to have been attained, they are considered a pest. Collinge adds that the United States must control the numbers of starlings to obtain benefit from their presence. Pitt (1935), writing in an illustrated English farm journal, considered the beneficial against the detrimental attributes of the starling and came to the conclusion that the bird is a blessing. Chapman (1907) has written that Americans have been warned by European ornithologists that the birds may become injurious to grain fields. At that time, Chapman seems to have considered the bird of less potential danger than the English sparrow, for he wrote, "The Starling is not so prolific, hardy or adaptive as that 'rat of the air,' the Sparrow. . ."

The berry-eating and fruit-pecking habits of the bird, coupled

with its known proclivity to drive out native species of hole-nesting birds and usurp their breeding places, are detrimental activities. Its tendency to flock, sometimes in large numbers, around our business and civic buildings, is well known in the Eastern States. The fact that the bird feeds upon grubs, grasshoppers, weevils and other pests of the farm, orchard, and truckgarden, is a beneficial attribute. Kalmbach (1937) calls our attention to the information that the starling is "recognized as one of the most effective bird-enemies of ground-inhabiting insects of the Eastern States."

Starlings and Cattle

It is the omnivorous nature of the feeding habits of the starling that has recently caused some alarm in the Middle West. Out of Kansas, Oklahoma, and Nebraska have come reports of starlings alighting upon the backs of cattle, ostensibly to remove ox warbles[1]. Alexander (1934) reported starlings followed cattle on a farm near Wellington, Kansas, in February, 1934, but makes no mention of the birds alighting upon the backs of the cattle. Through the winters of 1937 and 1938 the county agents of Chase and Comanche Counties, Kansas, received reports from stockmen that starlings were apparently probing the breathing apertures of ox warbles for the maturing grubs within their pits. This information did not reach print, but was reported to the writer and others by Dr. E. G. Kelly, Kansas State College Extension Specialist in Entomology, upon receipt of several letters during January, 1940, by Kansas State specialists that starlings were stampeding and injuring cattle in central Kansas.

Grub-infested cattle are greatly bothered by the attacks of starlings. After having been once attacked, cattle will stampede upon the sudden appearance of starlings. Dr. E. G. Kelly tells of watching a flock of starlings attack a herd of cattle, resulting in a stampede. That the flying birds outstripped the running cattle and turned them by swooping in front of the racing cattle is surprising evidence of the resourcefulness of the starlings in their new undertaking. A Kansas stockman has reported that a number of animals were in-

[1]Ox warbles are the immature stages of dipterous insects, **Hypoderma lineata** (De Villers) and **H. bovis** (De Geer), whose life cycles include a period of parasitic existence in tumors under the skin of cattle. The adult females deposit eggs upon hairs, generally near the fetlocks, from which point the hatched larvae drill through the skin to wander through the tissues of the host, finally to become lodged under the skin, usually in the loin region. At this site, each larva or warble drills an aperture through the skin, permitting the larva to take atmospheric oxygen into its respiratory system. After repeated ecdyses, the mature larva leaves its pit through the respiratory aperture, drops to the ground and there pupates. The escape of the larvae occurs in Kansas from about January 1 to May. The flies emerge from their puparia in late spring and early summer to live but a short time.

jured so severely by slipping in icy pastures while stampeding under attacks by starlings they had to be destroyed.

That the injury is real is attested by the following quotations from letters received by the Department of Zoology, Kansas State College, from stock-breeders and veterinarians:

". . .These birds light on the backs of cattle and cause them to stampede through the yard, the birds making a strenuous effort with their sharp beaks which cause wounds in the cattle's backs."

"I am wintering around 100 head of cattle around the barn, and see these birds light on the cattle's backs and pick, I suppose they pick the grubs out."

". . .They pick for the 'worm or bug' which are in the hide of the critter, and don't stop at that but go on for 'blood and meat'. . . Several of the animals have puss [sic] welts and size of a man's cap and are draining extremely."

"They are eating holes in the backs of our cattle. What is causing them to do this?"

". . .They were eating holes in his cattle, on the sides, backs and jaws. . ."

Though these quotations were taken from the letters of Kansans, the offense is by no means so localized. Through the courtesy of Prof. Myron Swenk, Department of Entomology, University of Nebraska College of Agriculture, reports have been received of similar instances within the State of Nebraska. Dr. John Mizelle, of the Oklahoma Agricultural and Mechanical College, supplied the information that a county agent at Alva, Oklahoma, and a farmer near Freedom, Oklahoma, have reported damage to cattle in those areas. Dr. George O. Hendrickson of Iowa State College has stated that there have been several reports of starlings alighting upon the backs of cattle in Iowa, even in barns, but apparently no harm was done. All of the records just considered were obtained during and immediately following a severe and protracted period of cold and snow throughout the mid-west area.

Texas cattle are also included in the starling attacks upon cattle in the midwest, as evidenced by the following sentences extracted from a letter received by Dr. E. G. Kelly from R. R. Reppert, Extension Entomologist, College Station, Texas:

"The other day in a section where we had been following out the program of cattle grub control, one of the ranchmen himself introduced the subject of starling injury by saying that the 'black birds' that were so numerous there had been seen inserting their bills into the holes made by the grubs for their full length and withdrawing the grubs. He made this statement with the evident impression that the birds were beneficial. . . he volunteered some additional information stating that an animal that recently died from some cause had been entirely consumed by the starlings before he had had opportunity to dispose of it otherwise. He took special pains to state that calves, coyotes or other animals had not thus disposed of it."

It has long been known that certain birds pick up the larvae of ox warbles as they drop to the ground to pupate (Bishopp et al., 1926). Instances of magpies (**Pica pica hudsonica** Sabine) attacking the backs of cattle, apparently for the grubs buried therein, are mentioned by Bishopp (op. cit., pg. 80). Why starlings should assume this habit is perhaps explained when one considers that the starling is a member of an old-world family of birds, among whose members are numbered at least two species of ox-peckers, rather aptly named Genus **Buphaga.** A quotation given us by Knowlton (1909) reads surprisingly like the letters quoted above. Knowlton writes:

> ". . .The African Ox-pecker (**B. africana**), which inhabits northeastern Africa. . . is generally met with in small flocks. . . Of its habits, Mr. Ayres writes as follows: 'During our stay in the bush, ox-peckers appeared in numbers about our oxen, and actually ate large holes in the fleshy parts of their backs, often one or two inches deep and two or three inches in diameter, thus creating bad sores. They do this little by little and day by day, attacking just that part of the back where the ox cannot swish them off with its tail or dislodge them with its horns. . . I have not seen any holes picked by these birds in the buffalo or other game, but only in the cattle.' "

It thus seems possible that under the stress of severe weather conditions and restricted food, the starlings are utilizing a racial instinctive adaptability possessed by other members of its family. One may account for the lack of damage in January to the Iowa cattle mentioned above with the knowledge that the warbles appear later in the backs of northern cattle than in the backs of southern herds. If severe conditions should exist in early March in Iowa and Wisconsin, it is possible reports of starling injury will be received from these areas.

Damage to cattle by starlings is not limited to attacks upon cattle infested with warbles. A report of starlings attacking branding wounds on cattle was investigated by men from Kansas State College. Examination showed several animals with raw and infected wounds, sometimes several inches in diameter, in place of the clear-cut brands of other animals. At the time of the visit, no starlings were feeding upon the wounds. The severity of the weather had moderated, seemingly making available normal food sources. Starlings were seen, however, in the tops of trees around the farmstead. It thus seems entirely possible that starlings will, under stress of food shortage, attack open wounds on animals as well as warble infestation.

Control of Starling Attacks

There is little that can be said at the present time about the control of starling attack upon cattle. It is doubtful that the birds will become a serious pest of range animals, because the starling is

essentially a bird of urban and field habits rather than a bird of the range land. The cattle of the feed lot and pasture, the dairy herd and feeder stock, suffer most.

Rifle and shotgun fire have been used by stockmen against the birds at feed lots and stables, with a degree of success. However, the birds are soon made wary of the hunter, and confine their attack to periods when no human being is in sight. Starlings have been decimated at their roosts by the concerted action of numbers of men with shotguns, all shooting at the same time and before the birds have opportunity to fly beyond range. They may be trapped in baited traps, particularly during periods of food shortage (Kalmbach, 1937). Starlings seem quick to learn the significance of such a device and cannot apparently be trapped more than once. Starlings range so widely in their feeding movements that the inability of laying poisoned bait at a sufficient number of feeding stations makes this method of control ineffective. An English gamekeeper successfully prevented starlings from occupying a roosting site by flying a hawk-shaped kite in the vicinity of the roost (Coward, 1929). It would be interesting to note the reactions of starlings around a feed lot if a hawk kite were flown in the neighborhood.

Experiments carried out under the knowledge of Dr. E. G. Kelly and the county agent of Comanche County, Kansas, indicated that a high degree of relief from starling attack may be obtained by the manual expression of ox warbles from their tumors as soon as the size of the warble and its pit makes this procedure practicable. Dr. J. W. Lumb, Kansas State Extension Specialist in Veterinary Medicine, suggests small herds be treated three times throughout the later winter months, and that larger herds be treated at least twice. This expression not only rids the pastures of the pupating flies and a subseqnent generation of warbles, but also permits the early healing of the breathing aperture and thus precludes the making of a flesh-wound or the infection of the warble tumor by attacks of the bird.

Adult warble flies live but a short time after emergence, and seem never to fly very far from the point of emergence. For this reason, successful control and elimination of warble infestation the subsequent year may be obtained by close-herding the animals from late December through March, followed by prompt removal of the livestock to a pasture at least a mile distant from the area where the larvae were dropped (Kelly, 1938). Needless to say, control of warbles is good farm practice from several points of view: it removes the parasite toxins from the blood of the host, thus strengthening the animal for the proper deposition of beef or production of milk; it makes for greater market value by avoidance of discounts for

warbly hides and by removing the necessity of trimming cuts of meat in areas occupied by warbles. Futhermore, elimination of warble infestation may solve the major cause of starling attacks upon cattle, permitting the mid-west area to benefit from the useful activities known to be performed by these birds.

Though the control of warbles would seem to eliminate one source of attack by starlings, it is to be remembered that open brands or other wounds may attract the birds during periods of extreme food shortage. Such wounds ought to be protected carefully by burlap shields, or wounded animals should be confined within tight buildings until the wounds have healed sufficiently to baffle starling attack.

Prospects in Future

Cartwright (1924), basing his statements upon an analysis of Christmas bird censuses, suggests the starlings are gradually shifting from city to country habits. Eastern ornithologists generally concede that starlings are gradually working southward in what may become a seasonal migration. Ewing (1924) states that starlings have an inherent tendency to migrate, but that this ability has been lost because of the new surroundings in the western hemisphere. He continues with the suggestion that starlings, loving the company of other birds, frequently join the flocks of grackles which assemble in the fall of the year for their migration southward, and remain with the grackles when they drift southward. It is thus possible, when the starlings have mastered the art of migration in their new homeland, that they will drift from our northern cities and thus relieve these cities of their undesirable winter population of these birds. If the great plains area is included in the area deserted by starlings upon the onset of winter, as it is deserted by grackles, then we may expect little damage to our cities and livestock on the part of the starling.

At all events, it may be assumed that the experience of stockmen during the severe weather of January, 1940, may not be soon repeated because of the number of factors which must reach their optimum at the same time to create the conditions met with this winter. There must be abundant flocks of starlings, severe cold and snow-covered ground, all at the time warbles are present in the backs of warble-infested cattle. If one or more of these factors are inoperative, no serious trouble need arise.

It would be well for interested ornithologists and stockmen to follow the suggestions of Collinge (1921), who recommends four steps leading to the better understanding and control of a bird species which may prove to be a decided pest to American agriculture. Collinge's points are: 1. systemmatically collect eggs from

starling nests and destroy autumn concentrations of the birds; 2. make farm buildings starling-proof; 3. maintain stringent regulations for the protection of birds of prey; 4. recheck the food habits of starlings at periodic intervals to guage their economic importance under varying conditions. All ornithologists agree that the starling is in America to stay. By sheer force of numbers, its insect-eating habits will make it more valuable to us than the indigenous birds it is bound to supplant. There is no doubt that locally, where its fruit-eating habits of certain seasons of the year, or where its attacks upon other animals make it undesirable, it must be controlled. No doubt effective methods of control will be forthcoming as the bird and its habits are better understood in its new enviroment.

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THE MEDICATION OF CATTLE FOR THE CONTROL OF HORN FLIES

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Preliminary experiments by Knipling (1938) have shown that larvae of the horn fly (**Haematobia irritans** (L.)) cannot develop in the droppings of cattle that are given orally certain quantities of phenothiazine. Other experiments along this line were conducted by the writer (1939), who by the close of 1938 had found phenothiazine to be the only material then tested which was effective. Although this chemical was effective in comparatively small doses (1 gram per hundredweight) it had certain undesirable qualities which made it unfit for general use. Experiments were therefore continued in 1939 in an effort to find a suitable chemical that would be toxic to the larvae of the horn fly but harmless to cattle.

Procedure. The experimental cattle were confined in a screened building at least 1½days prior to their medication and given a ration of bran and prairie hay. The chemical was administered by mixing it with the bran or water or, if it was distasteful to the animal, it was placed in a capsule and given with the aid of a balling gun. A sample of the droppings collected less than 3 hours before medication was used as a check. The animal was usually medicated at 4:00 p. m. and droppings were collected at approximately 8:00 a. m. and 4:00 p. m. each day thereafter for as many days as the test was in progress. Approximately 500 grams of the droppings from each collection, infested with 50 or 100 horn fly eggs, was placed on 800 grams of moist sand in a pan. Each sample was kept in an individual screen cage in the insectary, and the emergence of flies therefrom was recorded.

Results. The general results of 68 tests with 29 chemicals are shown in table 1. It will be noted that four chemicals gave a 100% kill in the doses indicated. Three of these are considered unsuitable for practical use. Azobenzene is extremely distasteful to cattle and therefore must be administered in a capsule. This, obviously, is an expensive, time-consuming process. In one test, a steer given 4.5 grams per hundredweight of azobenzene for 2 consecutive days became sore and stiff in the legs. Smaller doses had no apparent effect on the animal, but were not so effective against the horn fly larvae.

Similarly, 2,4-dinitrophenylhydrazine was distasteful to the cattle and had to be administered in a capsule. This chemical gave a 100% kill of larvae in droppings collected 16 hours after medication but no kill in droppings collected 8 hours later.

Table 1.—Toxicity of certain chemicals to horn fly larvae.

Chemical	Total No. of tests*	Dose, Grams per Cwt.	Administered in	Effect on Host	Approximate Kill, Per cent
Azobenzene	4	4.5	Capsule	Stiff joints	100
Benzophenone	1	4.5	Capsule	None	20
Borax	2	4.0	Bran	None	20
Copper nitrate	1	1.0	Bran	None	5
Copper sulfate	1	1.0	Capsule	None	50
Copper sulfate	2	†	Water	Solution distasteful	0
Cube (5% rotenone)	2	1.0	Bran	None	10
Cuprous oxide	1	2.8	Capsule	None	50
Derris (9% rotenone)	3	5.0	Bran	None	25
Derris (5% rotenone)	3	5.0	Bran	None	20
Dibenzyl	1	4.5	Capsule	None	60
2,4 dinitro-anisole	1	4.5	Capsule	Off feed, urine purple	10
2,4-dinitrophenyl-hydrazine	1	4.5	Capsule	None	100‡
Diphenyl	1	4.5	Capsule	None	10
Diphenyl-amine	1	1.0	Capsule	None	5
Diphenyl-guanidine	1	4.5	Capsule	Off feed, dopey	0
Diphenyl-sulfoxide	1	4.5	Capsule	Off feed, puffy around eyes	0
Iodoazo-benzene	1	2.0	Capsule	None	75
Methylene blue	1	4.5	Capsule	Laxative	75
Nicotine sulfate	1	§	Bran	None	40
p-Nitro-phenetole	1	4.5	Capsule	Lost weight	10
Phenothiazine	9	1.0	Bran	Discolors milk and urine	100
Phenothioxin	1	1.0	Bran	None	20
Phenylurethan	1	4.5	Capsule	Laxative	30
Pyrethrum	2	4.0	Bran	None	0
Rotenone	16	0.3	Bran	None	100
Sulfanilamide	1	1.7	Bran	None	10
Sulfur	1	4.5	Bran	None	0
Timbo (5% rotenone)	2	1.0	Bran	None	25
Tobacco (1.8% nicotine)	4	5.0	Bran	None	30

* Includes all tests with various doses as well as the dose indicated in the next column on which the succeeding data are based.

† 1 gram per gallon of drinking water.

‡ 100 per cent kill for approximately 16 hours, none at 24 hours.

§ 2 ounces of 0.4 per cent nicotine sulfate per hundredweight.

Phenothiazine was effective in doses as small as 1 gram per hundredweight but had the undesirable quality of imparting reddish tinge to the milk of cows. Furthermore, in doses of 2.25 grams or more per hundredweight this chemical produced certain physiological disturbances as indicated by the loss of appetite, gaunt appearance, dullness of the eyes, and nervousness.

Rotenone was the most effective chemical tested. Sixteen tests with doses ranging from 0.1 to 0.5 gram per hundredweight gave consistently excellent results without noticeable harmful effect to the animal. Doses as low as 0.1 gram per hundredweight gave a remarkably high kill of horn fly larvae. Doses of 0.4 gram per hundredweight killed all horn fly larvae in the droppings for approximately 30 hours. The minimum effective dose is 0.3 gram per hundredweight administered daily during the horn fly season. In one test, in which a 640-pound steer was given 1.9 grams of rotenone (0.3 gram per hundredweight) daily for 6 days, approximately 96% of the larvae were killed in droppings voided from the sixteenth to the fortieth hour after the first dose, and no larvae developed in subsequent droppings until 40 hours after the last dose. The few flies that developed in these droppings were so small and weak that it is doubtful whether they could reproduce.

Summary.—Sixty-eight tests with 29 chemicals were made to determine their value in preventing the development of larvae of the horn fly (**Haematobia irritans** (L.)) in the droppings of cattle. The chemicals were administered by mouth, either mixed with the bran or in water or in a capsule. Rotenone was effective in much smaller doses than any other chemicals and had no apparent harmful effect on the animal. The minimum dose of rotenone that killed all horn fly larvae was 0.4 gram per hundredweight. The droppings voided during a period of approximately 30 hours, beginning less than 10 hours after administration of this dose, were rendered unfavorable for the development of horn fly larvae. The minimum effective dose is 0.3 gram per hundredweight administered daily. A few flies emerged from droppings of cattle fed this dosage, but they were so small and weak that they probably would be unable to reproduce.

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NOTES ON OKLAHOMA BOT FLIES

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The damaging effects of this group of insects have been recognized for a long time, however the bionomics and controls, continue as problems of much controversy. The purpose of this paper is to present the heretofore unpublished records of specimens present in the Entomological Museum of Oklahoma A. and M. College, and some observations made by the authors on the bionomics of one species. All information, except where noted, is from adult material identified by David Hall and S. W. Bromley, to whom the writers are indebted for the determinations.

FAMILY GASTEROPHILIDAE

Gasterophilus intestinalis (DeGeer) (**G. equi** (Clark)). Wells and Knipling (1938) found that this was not the most abundant species present in the horses dissected in Illinois and Iowa, as had been expected. It is represented in the collection by: Five specimens, Stillwater, July 21, 1930 (H. Whitaker); two specimens, Stillwater, September 23, 1933 (R. Dahms); and one specimen from each of the following localities: Stillwater, September 21, 1931 (H. Whitaker); Cushing, June 15, 1932 (W. D. Davis); and Woodward, August 13, 1932 (W. D. Davis).

Gasterophilus nasalis (Linn.) (**veterinus** (Clark)). Contrary to popular opinion, Wells and Knipling (1938) found this to be the most abundant species in the vicinity of Ames, Iowa. It is apparently rare in Oklahoma, if the records serve as an adequate index; being represent by one specimen from Stillwater, October 25, 1934 (C. A. Sooter), one from Farris, November 5, 1934 (C. E. Sanborn), and one from Tulsa, April 28, 1938 (L. Harris).

Gasterophilus inermis Brauer. This species is apparently rare in Oklahoma. There is one specimen from Stillwater, May 14, 1932 (W. D. Davis) present in the collection.

FAMILY OESTRIDAE

Hypoderma lineata (de Villers). This species has often been confused with **H. bovis** (DeGeer), the two being of much economic importance in cattle, however, the latter species is not represented in the collection. The former species is represented as follows: Stillwater, April 13, 1936 (K. C. Davis); Perkins, April 17, 1932 and Stillwater, March 16, 1932 (M. L. Costner); and Stillwater, March 23, 1932 (W. D. Davis), each collection being represented by one specimen.

FAMILY CUTEREBRIDAE

Cuterebra cuniculi (Clark). As is the case with all members of this family, this species is very rare. It has a wide distribution in the United States, and published records show that the larvae are the most common bots to be found in rabbits in the Eastern States. It is represented by one specimen collected at Stillwater, May 15, 1932 (H. Whitaker).

Cuterebra (Bogeria) buccatta (Fab.). Painter (1930) lists this as being more common than C. **cuniculi** in Kansas. This in addition to the observations by the authors would suggest that this species is more prominent in the Middle West than in the Eastern States.

For a period of one year, January 1, 1939 to January 1, 1940, periodical collections of the Cottontail Rabbit (**Sylvilagus floridanus alacer** (Bangs)), were made at Stillwater, Oklahoma, totaling 197 rabbits for the year. Each month at least 5 and no more than 32 rabbits were collected; of this number, 6 were found to be harboring warbles. Five of the nineteen animals examined in June were found to be infested with these parasites; three larvae being removd from one rabbit. The sixth parasitized rabbit was taken on November 21. The specimens taken in June were found in the scrotum, while the one collected in November, was removed from the region of the loin.

The larvae taken June 11 were placed in moist sand at ordinary room temperature, and two flies emerged on August 25, one male and one female. They were identified by the authors as **Cuterebra (Bogeria) buccatta** (Fab.). The attempt to rear the last specimen was unsuccessful. The pupation period was close to, but no more than 74 days. One adult is present in the museum taken at Stillwater, September 10, 1930 (H. Whitaker). It is rather unfortunate that no work on the biology could be done during this period, since very little is known of the group.

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THE JUNIPER MIDGE, CONTARINIA JUNIPERINA FELT, A PEST OF RED CEDARS[1]

Ralph L. Parker[2] and Otto E. Wenger[3]

INTRODUCTION

During the years from 1935 to 1939 the terminal growths of red cedar trees were injured in various localities of Kansas. This injury was first attributed to winter drought or dry freezing caused by wind and cold or freezing of immature growth. Later this injury was identified as caused by the juniper midge. (Fig. 1). The present biological and control work was begun in February, 1939. Incomplete life history studies only were made during the late winter and spring in 1939. Later in the spring, adults that were reared from larvae collected while in hibernation beneath infested red cedar trees were identified as **Contarinia juniperina**[4], a new species of midge which attacks several varieties of red cedar. The determination was made by Dr. E. P. Felt of the Bartlett Tree Research Laboratories of Stamford, Conn.

DESCRIPTION OF STAGES IN THE LIVING STATE

Egg. The eggs are long, white and glistening and taper slightly toward one end. They are 0.133 mm. long, 0.025 mm. wide at the greatest diameter near the large end and 0.016 mm. wide at the small end.

Larva. The overwintering or mature larvae are small, bright orange, measuring 3 mm. long and 0.75 mm. in diameter. They have the characteristic chitinous organ on the ventral aspect of the prothorax known as the brest bone or sternal spatula, or anchor process.

Pupa. The puparia are about the same size as the mature larvae and are at first the same bright orange color but gradually change to a dull translucent condition.

Adult. The adult when first emerged is light orange in color but the abdomen soon becomes the same bright orange color as are the larvae. The thoracic region is dull light orange with a brownish cast and the large compound eyes make the head appear to be a brownish black in color. The wings are hyaline with delicate venation. The legs are the same color as the thoracic region and their extreme length gives the insect an awkward appearance.

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[1]Contribution 491 Department of Entomology.

[2]Professor of Entomology and Associate Entomologist, Kansas Agriltural Experiment Station, Manhattan.

[3]Graduate student.

[4]Felt, E. P. 1939. A New Juniper Midge (Diptera: Cecidomyiidae). Ent. News, 50:159-160.

BIOLOGY

Hibernation

Overwintering larvae were collected in moist soil not deeper than two inches beneath varieties of red cedar trees (**Juniper virginiana** L. and **J. chinensis** L.). Soil which had a shallow layer of mulch of fallen juniper needles appeared to be more inducive to the larvae. During February, 1939 many of the larvae still remained in the twigs of the trees. They were found between the dead end and the live portion of the twig. The infestation appeared to be widespread in Manhattan and vicinity with much injury to the red cedars. A few larvae were found in the twigs as late as the middle of March, 1939.

Life History

Egg. Oviposition was first observed on May 7, 1939, during the early evening when the humidity was rather high and little or no movement of air.

Larva. No observations.

Pupa. The first pupae were found in the soil under the trees on March 23, 1939. On March 30 about 50 percent of the larvae had pupated, by April 15 no larvae could be found in the field.

Adult. The first adults were collected April 25 from red cedar trees. By April 29 they were found in large numbers on these trees. A very few midges were found on May 20.

Habits

During the oviposition period adults were observed flying about the tips of branches which had new growth and flying to other such tips and attempting to oviposit on the new growth of each tip. Many times the midges appeared to oviposit on the new growth but not all samples of such selected new growth contained eggs. The eggs are laid near the middle of the needle and on the epidermis which is facing toward the supporting branch. The oviposition is only on new, tender plant growth near the tip of the twig. (Fig. 2).

CONTROL

Chemical

Since this injurious insect lives a part of the year in the soil, various treatments of the soil would be a possible means of control during the late fall, winter or early spring. On March 30, 1939, 8 plots measuring 1 square foot were laid out on infested soil beneath infested trees. There was a ¼ inch matting of needles on one half of the plots, the other half being exposed soil. The various chemicals were applied to the soil late in the day, between 4 and 6 o'clock. The air temperature at this time was 72° F. and there was a slight

south breeze blowing.

Two treatments with a 20 percent ethylene dichloride emulsion, one with dichloroethyl ether, and one with paradichlorobenzene were applied to separate plots.

The ethylene dichloride emulsion was made according to the method of Oliver I. Snapp[5] of the Bureau of Entomology and Plant Quarantine. This emulsion was prepared by following the standard formula of mixing slowly and thoroughly 9 parts by volume of ethylene dichloride into 1 part by volume of potash fish-oil soap, and stirring in slowly 9 parts by volume of water. This is a 50 percent stock emulsion which can be further diluted for use. The 20 percent emulsion was made by mixing 6 parts of water with 4 parts of the 50 percent stock emulsion. In one experiment in which ethylene dichloride emulsion was used, the soil was stirred and turned over by hoeing. One pint of this emulsion was applied to each of the two square foot plots in duplicate.

The dichloroethyl ether was applied in a 20 percent agitated mixture of water at the rate of 1½ pints to the two square foot plots.

The third plot was treated with 1 ounce of paradichlorobenzene to the two square foot plots and then hoed into the top 1½ inches of soil.

A check plot of no treatment was included in the series. The top soil on each of the treated plots was well soaked to a depth of ¼ to ½ inch except the paradichlorobenzene plot.

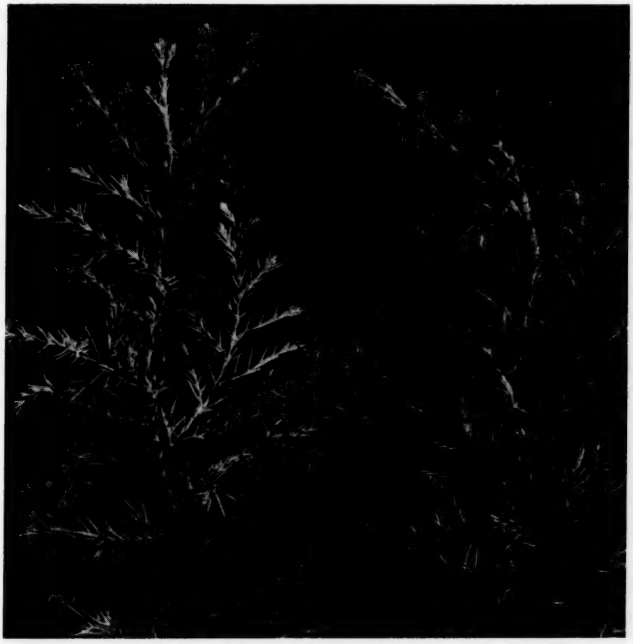
Samples of the treated infested soil from each of the plots were examined on April 7 for live and dead larvae and pupae. All larvae and pupae were dead in each sample of treated soil. After the examination counts of soil sample had been made they with the insects found were placed in rearing jars as a final determination of the insecticide effectiveness. From these samples in the jars several **Platygaster** n. sp. (undescribed) emerged but no juniper midges. Samples of infested soil from the check plot were placed in rearing jars from which midges emerged normally.

PARASITES

In the laboratory, hymenopterous parasites emerged from larvae which were collected from hibernation in the soil. The proportion of parasites to adult emerging was rather high for those which were reared in the laboratory. There were 64 midges and 177 parasites

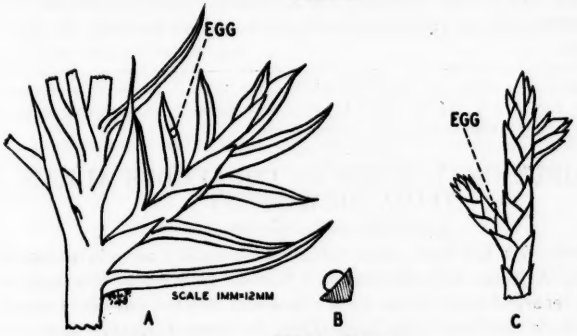
[5]Snapp, Oliver I. 1938. Recent experiments with ethylene dichloride emulsion for peach borer control. Jour. Econ. Ent. 31:725.

—— 1939. Further studies with ethylene dichloride emulsion for the control of the peach borer. Jour. Econ. Ent., 32:683-685.



INJURED **Juniper Midge Injury** NORMAL

FIG. 1



JUNIPER CHINENSIS L. CROSS SECTION OF NEEDLE WITH EGG JUNIPER VIRGINIANA L.

LOCATION OF JUNIPER MIDGE EGG ON PLANT

FIG. 2

reared from this collection of specimens. The parasite **Platygaster**[5] (species undescribed) was the dominating parasite. One other specimen represented a female of a species in the genus **Inostemma**[6].

Habits

In the laboratory experiment, the adult midges began to emerge rapidly at first but in a few days were replaced by an increasing number of parasites.

The hymenopterous parasite **Platygaster** (species undescribed) on April 29 and during the fore part of May was observed in large numbers flying in and out among the needles of the new tender growth of the cedars during the period of its host oviposition. It evidently was too early for larval parasitism to take place but the parasites were seeking the proper stage of its host for egg laying. It would appear that there would be an extremely high parasitism of the juniper midge by this parasite. Parasitized juniper midge papae are easily recognized by the appearance of 1 to 3 parasite pupae within them.

SUMMARY

1. A new species of insect injurious to red cedar trees is identified to be **Contarinia juniperina** Felt, the juniper midge.

2. A description of the life stages of the insect are given.

3. The insect hibernates in the injured twigs or surface soil beneath infested trees.

4. Soil fumigants ethylene dichloride emulsion, dichloroethyl ether and paradichlorobenzene applied during the early spring to infested soil either bare or covered with needles, gave effective control of such hibernating insects.

5. An undescribed species of a hymenopterons parasite in the genus **Platygaster** appeared in great numbers from its host the juniper midge.

[5]Determination was made by Mr. C. F. W. Muesebeck, Div. Insect Identification, Bur. Ent. and P. Q., U. S. D. A. This **Platygaster** is an undescribed species near **P. pini** Fouts and **P. feltii** Fouts.

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DISTRIBUTIONAL NOTES ON COPAEODES AURANTIACA (HEWITSON)

(Lepidoptera: Hesperiidae)

This species has been recorded as being native only in parts of California, Arizona, New Mexico and Texas. In Kansas this species has been recorded as a visitor to Wallace and Scott counties. Indeed, only a single specimen has been taken in Scott County. Recently Dr. Turner and Mr. D. Stallings of Caldwell, Kansas have taken six or so pairs of this species in Sumner County, thus establishing the fact that it is native to Kansas.

WILLIAM D. FIELD, Lawrence, Kansas

THE GENUS COCHLORHINUS UHLER AND SOME RELATED GENERA OF LEAFHOPPERS HOMOPTERA-CICADELLIDAE

R. H. Beamer, Lawrence, Kansas*

Uhler erected the genus **Cochlorhinus** in 1876 for the single new species **pluto.** Ball in 1902 made the genus **Uhleriella** designating **Deltocephalus coquilletti** Van D. as the type. In the same paper he placed two new species, **stygica** and **signata** in this genus. In 1915 he erected the genus **Drionia** for another new black and white leafhopper, which he called **nigra,** and named two more species of Uhleriella, **ziczac** and **pasadena.** This group of leafhoppers presents a very interesting problem in taxonomy. They are all very closely related, as is at once evident, by their external appearance and a study of the male genitalia. They are all found in California and the black ones, at least, are usually collected upon grasses.

In this paper **Uhleriella** is sumerged as a synonym of **Cochlorhinus; Drionia** is retained due to its very different external appearance although the internal male genitalia are very close to **Cochlorhinus;** the new genus **Calonia** is proposed for **Uhlariella signata** which has but one cross-nervure instead of two as in **Cochlorhinus;** the new name **Cochlorhinus unispinosus** is proposed for **Deltocephalus coquillettei** Van D. because Osborn and Ball made it a homonym by placing it in the genus Thamnotettix in 1897; and one new species, **Cochlorhinus bidentatus** is described.

Key to Genera

1. Margins of vertex parallel ---------- **Drionia**
   Margins of vertex not parallel ---------- 2
2. With two cross-nervures ---------- **Cochlorhinus**
   With one cross-nervure ---------- **Calonia**

Drionia Ball

Ball, E. D., Proc. Biol. Soc. Wash., p. 167, 1915.

Resembling **Cochlorhinus** but vertex much wider than long, margins almost parallel, vertex rounding to front, face protuberant, body short and stout. Genotpye: **Drionia nigra** Ball.

Drionia nigra Ball

Drionia nigra, Ball, E. D., Proc. Biol. Soc. Wash., p. 167, 1915.

Described from two males and two females from Medford, Oregon, and in collection of E. D. Ball. There are at hand in the Snow Collection 90 specimens collected at Redding, California, June 28, 1935, 60 of which are typical. The other 30 are albinistic individuals with elytra hyline, veins white, and only a dark spot on vertex, pro-

*Contribution from Department of Entomology, University of Kansas.

notum and scutellum remains of the usual black color.

Internal Genitalia: Pygofer about as wide as long, somewhat rolled in on apical third, with two inwardly projecting spines. Aedeagus with shaft almost straight, enlarged in lateral view at apex with two pairs of processes about half as long as shaft, arising just before apex on ventral side, and one pair of processes about as long as others on dorsal side, near outer third.

Specimens at Redding, California, were collected by sweeping the heads of a grass growing about 18-20 inches in height.

Cochlorhinus Uhler

Uhler, P. H., Bul. U.S.G.S., No. 5, p. 385, 1876.

Resembling **Drionia** in color and ventation, but vertex sharp, margins not parallel, face not tumescent. Body normal, not stout; elytra with two cross-nervures, covering abdomen; pygofer usually with two apical spines.

Genotype: **Cochlorhinus pluto** Uhler.

Key to the Species of **Cochlorhinus**

1. Only a white dash on cross-veins, remainder of dorsum black ---------- 2
   At least some of other veins white ---------- 3
2. Vertex acute, longer than wide ---------- **pluto**
   Vertex about a right angle ---------- **stygicus**
3. White middle cross-band of pronotum distinct ----------4
   White middle cross-band of pronotum absent, or nearly so ---------- **ziczac**
4. Male plates short, semicircular, pygofer short, with one long spine; lateral margins of last ventral segment of female not broadly rounded to posterior margin ---------- **unispinosus**
   Male plates long; pygofer with two spines; lateral margin of last ventral segment of female broadly rounded to posterior margin ---------- 5
5. Vertex from eye to eye rounded, greater than a right angle, male plates with apices sharp ---------- **pasadenus**
   Vertex from eye to eye sharp, about a right angle, male plates with apices rounded ---------- **bidentatus**

Cochlorhinus pluto Uhler

Cochlorhinus pluto, Uhler, P. R., Bul. U.S.G.S., No. 5, p. 358, 1876.

A long, sharp-headed leafhopper, black throughout except broad band across face, white dash on cross-veins and portions of legs white.

Genitalia: Last ventral segment of female about one-third longer than preceding, lateral angles rounded to a median notch occupying

one fourth width of segment and half as deep as wide. Male pygofer with rounded apices, with two moderately long spines extending toward opposite side; plates about as long as combined width at base, evenly tapered to fairly sharp apices; aedeagus about as long as plates, in lateral view straight, tapered slightly from base to a rounded apex, ventral margin with two pairs of basally projecting processes about as long as shaft; dorsal margin with one pair of processes arising near outer fourth and about half as long as ventral processes.

Cochlorhinus stygicus (Ball)

Uhleriella stygica, Ball. E. D., Can. Ent., p. 55, 1902.

Resembling C. **pluto**, but vertex much shorter, about a right angle.

Genitalia: Last ventral segment of female about one third longer than preceding, lateral angles rounding to a median notch occupying about one third width of segment and one third as deep as its own width. Male pygofer about twice as long as wide, with two short apical spines projecting toward opposite side; plates about as long as combined basal width, roundingly narrowed to fairly sharp apices; aedeagus about as long as plates, in lateral view shaft straight, slightly tapered to enlarged, rounded apex with two pairs of spines on ventral margin just before apex, reaching about one third length of shaft, and one pair on dorsal margin, reaching to about same place as ventral.

This species is very close to C. **pluto** in internal genitalia. The pygofer is a little broader at apex, the aedeagus is slightly broader in lateral view, and the processes are not so long. It may be possible that this is just the short-headed extreme of C. Pluto.

Cochlorhinus ziczac (Ball)

Uhleriella ziczac, Ball, E. D., Proc. Biol. Soc. Wash., p. 166, 1915.

Resembling C. **unispinosus**, but with much more black coloring, sometimes a small second spine on pygofer and long plates.

Genitalia: Last ventral segment of female about twice as long as preceding, lateral margins angularly narrowed, exposing large underlying membrane, posterior margin shallowly and broadly notched. Male plates about as long as combined basal width; pygofer about one third longer than middle width, one median tooth and occasionally a second smaller tooth at apex; aedeagus in lateral view slightly bent dorsally on outer third, with a pair of lateral, occasionally bifid, processes arising just before apex and extending toward base of shaft about one third length, a dorsal, much shorter, retrorse pair of processes arise near bend in shaft.

This species seems to be about midway in coloring between C. **stygica** and C. **unispinosus**. There is also apparently considerable

variation in the number of spines on the pygofer and in whether the processes on ventral margin of aedeagus are single or bifid.

Cochlorhinus unispinosus, new name

Deltocephalus coquillettei, Van Duzee, E. P., Ent. Ame., VI, p. 95, 1890.
Thamnotettix coquillettei (V. D.). Osborn and Ball, Proc. Iowa Acad. Sci., IV, p. 221, 1897.
Uhleriella coquillettei (V. D.), Ball, E. D., Can Ent., XXIV. p. 55, 1902.

This species was described by Van Duzee in 1890 in the same paper with another new species, **Thamnotettix coquillettei.** In 1897 Osborn and Ball placed **D. coquillettei** in the genus **Thamnotettix**, thus creating a homonym. According to the rule, once a homonym, always a homonym, one of these two names must be changed. Since the original, **Thamnotettix coquillettei**, has page preference, the name **Cochlorhinus unispinosus** is suggested for **Deltocephalus coquillettei** Van Duzee.

Externally **C. unispinosus** is very close to **C. pasadenus** and **C. ziczac** and still closer to the new species **C. bidentatus.** This latter species, however, has the aedeagus of **C. unispinosus** and the pygofer with the two spines of **C. pluto. C. unispinosus** could not, therefore, logically be separated generically from this group of species. The males may be separated by the short, almost semicircular, plates and the females by the very narrow, angular, last ventral segment with its slightly excavated posterior margin.

Genitalia: Last ventral segment of female about one third longer than preceding, lateral margins converging, very slightly rounding to shallowly, evenly excavated, posterior margin, which is about half as wide as basal margin. Male plates broadly rounded, together forming about a semicircle; pygofer much shorter than plates, much wider than long, with long, slender spine on inner angle next anal tube; aedeagus in lateral view with shaft curved near middle, apex enlarged, rounded with a pair of retrorse, bifid processes arising before apex, and a pair of simple, shorter processes on dorsal margin.

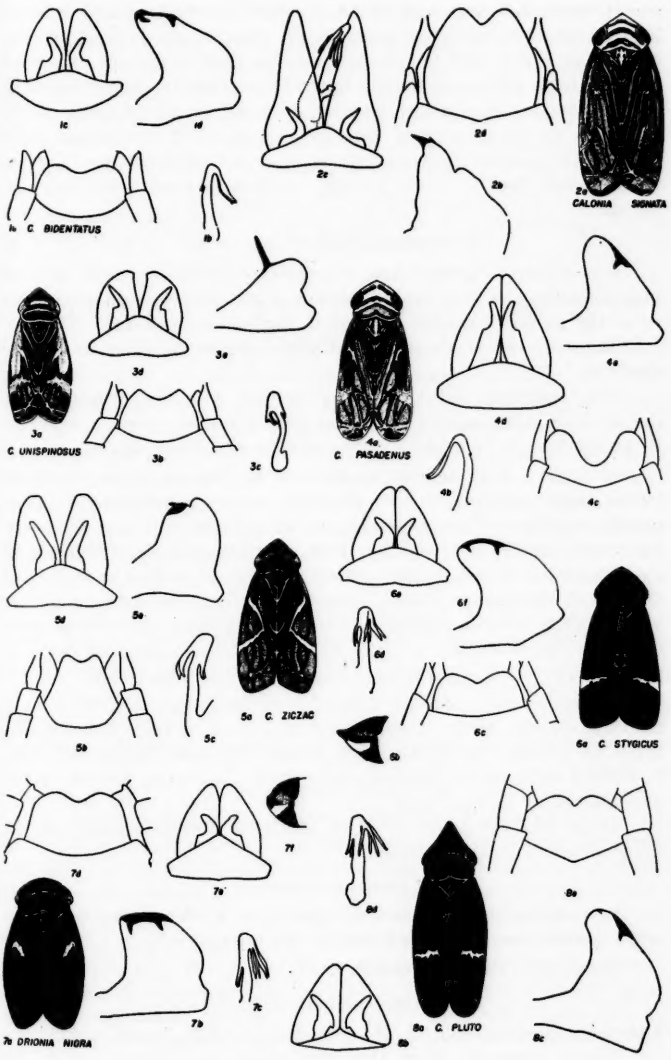
Neoholotype male and neoallotype female, California, Coquillett, a pair of Van Duzee's cotypes in the Iowa State College Collection, Ames, Iowa. are here designated.

Cochlorhinus pasadenus (Ball)

Uhleriella pasadena, Ball, E. D., Proc. Biol. Soc. Wash., XXVIII, p. 166, 1915.

Resembling **C. unispinosus** externally and **C. stygica** in genitalia. From the former it may be separated by the broader, more rounded, vertex, and from the latter by the many white markings.

Genitalia: Last ventral segment of female slightly longer than


1c
1d
2c
2d
2a CALONIA SIGNATA
2b
1a C. BIDENTATUS
1b
3a C. UNISPINOSUS
3d
3e
3b
3c
C. PASADENUS
4a
4d
4b
4c
5d
5e
5a C. ZICZAC
6a
6f
6d
6b
6c
6a C. STYGICUS
5b
5c
7d
7e
7f
8d
8e
7a ORIONIA NIGRA
7b
7c
8a C. PLUTO
8b
8c

preceding, margins straight, rounding to posterior margin. which is evenly excavated half way to base. Male plates long and pointed longer than their combined basal width; pygofer about twice as long as median width with one large spine on ventral margin one third distance from apex, aedeagus in lateral view slightly curved throughout its length, sides almost parallel, with a pair of retrorse, dorsal processes at tip more than half as long as shaft, widest on their outer third, ventral processes reduced to a pair of small teeth; styles much longer than in other species, reaching beyond outer third of plates.

Cochlorhinus bidentatus, n. sp.

Resembling C. **unispinosus**, but males with longer, more pointed plates and females with lateral margin of last ventral segment rounded to the posterior margin instead of angled. Length 4.25 - 5 mm.

Shape of vertex about a right angle, wings about as in C. **unispinosus.**

Color markings about as in that species, with the exception that the anterior white cross-band on pronotum reaches margin while in C. **unispinosus** it is usually surrounded by the black bands.

Genitalia: Last ventral segment of the female about one third longer than preceding, lateral margins broadly excavated its entire length. rounding to posterior margin, which is broadly and shallowly excavated. Male plates about as long as combined basal width, fairly sharp pointed; pygofer about twice as long as median width, apex sharp with two spines, one at tip and one before; aedeagus in lateral view slightly curved, widest at base, with a pair of retrorse processes at tip on ventral margin more than half as long as shaft, a pair of retrorse, dorsal proceses reduced to very short teeth.

Holotype male, allotype female, and three male and 24 female paratypes, above Mint Canyon, California, June 7, 1935. Other paratypes as follows: 5 females and 1 male, Saugus, California, June 7, 1935; 1 male and 2 females, Cajon Pass, California, June 6, 1935; all collected by P. W. Oman.

Types and paratypes in U. S. National Museum, paratypes in Snow Entomological Collection.

Calonia, new genus

Resembling the light-colored species of **Cochlorhinus**, but with one cross-nervure instead of two in the elytra.

Genotype: **Calonia signata** (Ball)

Calonia signata (Ball)

Uhleriella signata, Ball, E. D., Can. Ent. XXXIV. p. 56, 1902.

Easily separated from the other black and white species by having but one cross-vervure, by the long sharp plates of the male,

and the very long, last ventral segment of the female.

Dr. Ball's original description very clearly portrays this species.

Genitalia: Male plates long and sharply triangular; pygofer extending beyond plates. but when open on a slide is almost as wide as long, roughly bilobed with inner lobe narrow and ending in a double spine; aedeagus in lateral view slightly bent dorsally on outer third, with a pair of retrorse processes on other margins about one third as long as shaft, ventral pair arising slightly nearer apex than dorsal.

Numerous specimens at hand swept from a wild, plum-like shrub in Mint Canyon, California, July 6, 1933.

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A DISTRIBUTION NOTE ON GRAIS STIGMATICUS (MABILLE)

(Lepidoptera: Hesperiidae)

This species is found from southern Brazil north through Mexico. In the United States it has been recorded as probably being native around Kerrville, Texas where numerous specimens have been taken during the month of September. The writer has taken it also at Ft. Stockton, Texas on July 11, 1936. Calkins[1] states that three or four specimens of this species have been taken late in the summer in Scott County, Kansas. All of his species were taken after dust storms or strong southern winds. This species can be regarded as native to southern Texas but only a visitor to Kansas.

[1]V. F. Calkins, "The Rhopalocerous Lepidoptera of Scott County, Kansas," Ent. News, vol. XLIII, p. 259, Dec., 1932.

WILLIAM D. FIELD, Lawrence, Kansas

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A NEW SKIPPER RECORD FOR THE UNITED STATES

(Lepidoptera: Hesperiidae)

A single specimen of **Thymele fulgerator** Walsh was taken at Donna in Hidalgo County, Texas by Miss Calla Stainke on November 10, 1935. It is entirely unlikely that this species is anything other than one of the numerous visitors that cross our border from Mexico from time to time. **T. fulgerator** is common in various parts of Mexico and is found from there south to Columbia and Brazil. The genus **Thymele** F. is a rather large tropical genus containing something like thirty-two species. This is the first record of any member of the genus being found as far north as the United States. Dr. A. W. Lindsey of Granville, Ohio has checked my determination of the specimen.

WILLIAM D. FIELD, Lawrence, Kansas

NEW MID-WESTERN DOLICHOPODIDAE (Diptera)[1]

F. C. Harmston and G. F. Knowlton[2]

The following report consists of descriptions and figures of two apparently undescribed long-legged flies from Illinois and one from North Dakota[3].

Argyra similis n. sp.

Male. Length, 4 mm.; of wing, 3.3 mm. Face narrow, densely silvery pollinose; palpi yellow, whitish pollinose, their surface with long pale hairs near tip; front concolorous with face, its pollen dense; antennae (fig. 2) black, first joint short, glabrous, joint III longer than combined length of joints I and II; arista inserted near the tip of third joint, longer than antenna, slightly pubescent; lower orbital cilia and whiskers white, upper cilia black, delicate.

Dorsum of thorax and the scutellum greenish metallic, the reflections somewhat coppery, surface of both dulled with white pollen; pleurae darker, its ground color hardly perceptible through the dense whitish pollen; abdomen with first segment black, dulled with white pollen, the whitish hairs on lateral margin long, delicate; second and third segments wholly yellow except narrowly along dorsal incisures; fourth, fifth and sixth segments black, their upper surfaces densely pubescent, entirely hiding the ground color; hairs and bristles of abdomen yellowish, yet the larger bristles along the incisures appearing brownish in certain lights; hypopygium (fig. 9) black, rounded behind, the outer lamella yellow, slender, fringed with yellowish hairs; inner lamella wholly yellow. Halteres dark yellow; calypters yellow with narrow brown tip, their cilia yellow.

All coxae, their hairs and bristles yellow; femora, tibiae and tarsi yellow; fore and middle femora with delicate whitish hairs on lower and posterior edges; posterior femora with delicate whitish hairs on lower edge, especially near the base; joints of fore tarsi as 15-6-5-3-3; of middle tarsi as 15-5-5-3-2; of hind tarsi as 10-10-8-4-3.

Wings (fig. 4) grayish hyaline, broad, especially near base; veins brownish yellow.

Described from one male taken at Dongola, Illinois, May 11, 1917. Type in the Illinois Natural History Laboratory.

Taxonomy. This species is closely related to **Argyra (Leucostola)**

[1]Contribution from the Department of Entomology, Utah Agricultural Experiment Station.

[2]Research assistant and research associate professor, respectively.

[3]Species here described were present in material from the Illinois Natural History Survey and University of Utah insect collections received for identification.

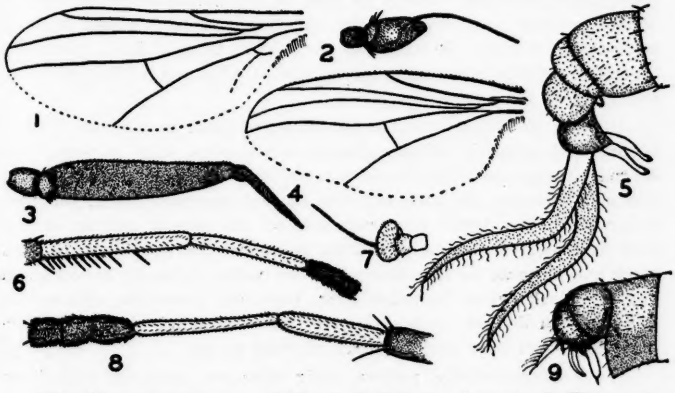
johnsoni Van Duzee. In **johnsoni** the cilia of the inferior orbit are yellow whereas in **similis** n. sp. the orbital cilia are white; the wings of **johnsoni** are tinged with brown in front of the fourth vein but are entirely grayish hyaline in **similis**; **johnsoni** has the second joint of middle tarsi more than one-half the length of first joint, whereas the first joint of the middle tarsi in **similis** is three times the length of the second joint. Both **similis** and **johnsoni** resemble **cingulata** Loew, but in the latter species the abdomen is wholly without pollen.

Chrysotus chlanoflava n. sp

Male. Length, 2 mm.; of wing, 1.7 mm. Face narrow, the eyes barely separated below; lightly dusted with yellowish brown pollen, barely allowing the green ground color to show through; front metallic green, its central portion dull bronze, appearing rough, but without pollen; palpi small, white, a few delicate blackish hairs near the tip; antennae (fig. 7) yellow, the third joint pubescent, short, broad, obliquely rounded anteriorly; arista apical, slightly longer than antenna; orbital cilia, including uppermost, white.

Thorax metallic green, lightly dusted with white pollen, the dorsum with bronze reflections; pleurae with the pollen more dense; abdomen metallic green with bronze reflections; bristles of thorax black, those of abdomen yellowish, yet the latter appearing brown in certain lights; hypopygium small, black, its appendages partly imbeded, consisting of a pair of small yellowish outer lammellae which are densely ciliated, and a slender, posteriorly projecting organ.

Fore coxae yellow, their anterior surface with white hairs; middle and hind coxae concolorous with pleurae, their tips narrowly yellow;



Rhaphium rossi n. sp. Male, 1, 3, 5-6, 8. **Argyra similis** n. sp. Male, 2, 4, 9. **Chrysotus chlanoflava** n. sp. Male, 7.

femora and tibiae yellow; fore tibiae without bristles; middle tibiae with three black bristles on outer posterior side, two on basal half, the other at tip; hind tibiae with three pairs of bristles, and a narrow glabrous line separating their bases; all tarsi of plain structure, the fore and middle pairs yellow, infuscated only at the extreme tip; hind tarsi slightly infuscated from the tip of first joint; halteres, calypters and their cilia pale yellow.

Wings grayish hyaline; cross-vein situated before the middle of wing.

Female. Length. 2.6 mm. Face wider than in male, its pollen gray; pulpi broad, infuscated at base, the bristles near margin stronger than in male; third joint of antennae brownish; legs as in male except that fore coxae and tarsi are somewhat more infuscated.

Described from 3 males and 2 females taken at Tower City, North Dakota, June 23, 1906 (M.W.R.).

Holotype and allotype in the University of Utah collection; paratypes in the Utah Agricultural Experiment Station and the U. S. National Museum insect collection. **Taxonomy.** Chrysotus chlanoflava n. sp. traces to the first part of couplet 69 of the Van Duzee key (Buffalo Soc. Nat. Sci. Bul. 13:10, 1924) differing, however, in the palpi being short.

Rhaphium rossi n. sp.[4]

Male. Length, 4.6 mm.; of wing, 3.8 mm. Face short, leaving the lower fifth of the eyes sharply exposed, moderately wide, silvery pollinose; front metallic blue-green, pollinose only near the base of antennae; palpi black, their apical margin fringed with white, flattened hairs, which are nearly as long as the palpi; antennae (fig. 3) black, the third joint nearly twice the length of face; arista slightly more than one third the length of third joint, thick at base, gradually tapering, densely pubescent; lower orbital cilia and whiskers white, about six of the upper cilia black.

Dorsum of thorax and the scutellum metallic blue-green, lightly dusted with whitish pollen; pleurae concolorous with dorsum, less shining, its ground color almost completely hidden by whitish pollen; abdomen metallic, the anterior half of each segment black, the posterior half blue; lower posterior half of the lateral margin of the first five segments densely whitish pollinose; hairs of the abdomen black except those on the sides which are white, delicate; hypopygium (fig. 5) black; outer lamellae long, tapering, brownish, ribbon-like. fringed with delicate yellowish cilia; inner lamellae slender, finger-like, largest at base and slightly enlarged at tip.

Fore coxae wholly yellow, their anterior surfaces with long,

[4]Named in honor of Dr. H. H. Ross of Illinois Natural History Survey.

dense, white hairs; middle and hind coxae blackened, their tips yellowish; middle coxae with white hairs on their anterior surfaces and with two long, black bristles, lying close together which arise near the apical fourth, without spine at tip; hind coxae with a few delicate white hairs near base and a single, small whitish bristle near the middle on outer side; femora yellow, tips of posterior pair darkened at tip above; fore femora with long, delicate, white hairs on outer surface; tibiae yellow, tips of middle and hind pairs narrowly blackened; hind tibiae noticeably thickened and having a narrow, glabrous stripe on their posterior surface; tarsi with first two joints yellowish, the remaining joints black; fore tarsi plain, the fifth joint slightly widened; middle tarsi (fig. 6) with first and second joints long, the former spinulose below, last three joints short, fringed laterally forming a brush-like tip, hind tarsi (fig. 8) with first two joints nearly white, second jont nearly one and one-half times the length of first joint, last three joints black, fringed laterally, forming a conspicuous, somewhat brush-like tip; joints of fore tarsi as 10-6-3-2-5; of middle tarsi as 20-15-3-3-3; of hind tarsi as 14-20-5-4-4; halteres, calypters and their cilia pale yellow.

Wings (fig. 1) grayish hyaline, lightly tinged with brown in front of third vein.

Female. Like the male except that the third antennal joint is narrower, tarsi are plain and the wings are longer and narrower. The face of female is much wider than in the male and of darker color, the palpi are broader and lack the dense marginal fringe of flattened, white bristles, so conspicuous in the male.

Described from 15 males and 8 females, taken at Golconda, Illinois. April 18, 1914. Holotype, allotype and several paratpyes at the Illinois Natural History Laboratory; paratypes in the Utah Agricultural Experiment Station insect collection.

Taxonomy. The male of **Rhaphium rossi** n. sp. traces to couplet 45 of the Curran key (Roy. Can. Inst. Trans. 15:256) where it would form a third alternative, "palpi small, black, fringed along margin with white, flattened hairs." The female traces to **lugubre** Loew, in the key to females, page 257, differing from that species in the color of hind femora and tibiae, which are black in **lugubre**, yellow in **rossi.**

A NEW SPECIES OF THYREOCORINAE

R. I. Sailer, Lawrence, Kansas*

Galgupha loboprostethia sp. nov.

General Characteristics: Body broad, slightly obovate, shining black. Antennae, tarsi and rostrum testaceous. Last segment of antennae darkest. Body distinctly punctate except on disc of both the pronotum and scutellum where the punctations are obsolete. Punctures deepest and most evident in pronotum behind anterior angles.

Head not produced more than length of eye beyond transocular line. Front margin more or less truncate. The tylus usually produced slightly. Lateral margins thickened and perceptibly reflexed near apex causing apex of disc to be somewhat concave. Lobes in front of eyes distinctly punctured. Posterior marginal area of disc impunctate. Few punctures on tylus.

Prostethium decidely concave beneath eye and with the anterior margin produced to form an explanate lobe usually covering a portion of the base of the first antennal segment. The ventral anterior and ventral margins very finely striate.

Sternites coarsely punctate laterally with scattered obsolete punctures on median strip. Sixth sternite broadly rounded anteriorly in both male and female. Sixth sternites in male less than length of three preceding sternites together.

Hypopygium of male very lightly punctate and slightly transversly channeled. Its width between lateral angles usually less than length of sixth sternite. Length is to the width as :60 is to 7:00. The hind margin reflexed and noticeably concave medially. A conspicrous tuft of hair evident in this concavity. Dorsal rim broad and flat all around and not deeply excavated interiorly.

Sixth sternite of female scarcely equal in length to the preceding two sternites together. Genital plates punctate, about half as long as sixth sternite and about equal to postventer. Inner margin two-thirds as long as posterior and the latter slightly concave.

Length, 3.70-5.20 mm.

Comparative notes: Most closely related to **G. ovalis** Hussy, and in McAtee and Mallochs monograph of the Thyrocorinae keys out of this species. This species differs from **G. ovalis** in a number of characters as follows: Average size somewhat smaller. The punctation of the body is more evident, particularly on the head. The apex of the head disc always perceptibly concave on each side of tylus. This is invaribly flat in **G. ovalis**. The tuft of hair in the concavity.

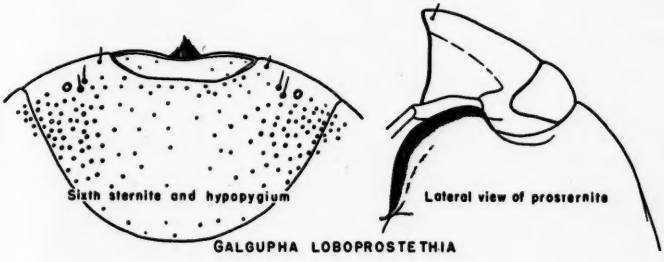
*Contribution from Department of Entomology, University of Kansas.

of the hind margin of hypopygium is absent in G. **ovalis**, and the length of the hypopygium in relation to its width is noticably less. The most important feature of difference is the shape and the striate character of the margin of the prostethium.

This, to the extent of my knowledge. differs from all species of Thyrecorinae recorded from the U. S. with the possible exception of G. **hesperia** McA. and M. described from Calif. Specimens of the herein described species have been compared with G. **hesperia** by H. G. Barber of the U. S. National Museum.

Distributional data: Douglas Co., Kans.; Medora, Kans.; Johnson Co, Kans.; Chautauqua Co., Kans; Neosho Co., Kans; Bourbon Co., Kans.; Reno Co., Kans.; Garnett, Kans.; Yates Center, Kans., Scott Co., Mo.; Atherton, Mo.; Green Co., Mo.; Howard Co., Ark.; Woodward, Okla.; Wasta, S. D.

Types: Holotype, male, Douglas Co., Kans.; Allotype, female, Douglas Co., Kans.; 36 paratypes in the Francis Huntington Snow collection of the University of Kansas. 26 paratypes in the U. S. National Museum Collection.



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